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# Exploration of Mathematics: Investigating the Continuum of Mathematics from the Middle Years Program to the Diploma Program at International Baccalaureate Schools

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# Exploration of Mathematics: Investigating the Continuum of Mathematics from the Middle Years Program to the Diploma Program at International Baccalaureate Schools

## **Abstract**

The purpose of this action research was to study the continuum of the mathematics curriculum from the Middle Years Program (MYP) to the Diploma Program (DP) at an IB School in Jakarta, Indonesia. To investigate the continuum of the mathematics curriculum from MYP to DP, data from the assessments of each program was collected from 2014-2016. The participants in this research were 44 grade 12 students who had already taken the DP Mathematics external examination. Their final mathematics scores were compared to their level of achievements in MYP Mathematics in grade 10. The results of the study were mixed, indicating that the continuum between MYP and DP needs more review and strengthening.

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The Exploration of Mathematics: Investigating the Continuum of Mathematics from the Middle  
Years Program to the Diploma Program at International Baccalaureate Schools

by

Stela Irene Tampubolon

M.Ed. Dordt College, 2017

Action Research Report  
Submitted in Partial Fulfillment  
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Department of Education  
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The Exploration of Mathematics: Investigating the Continuum of Mathematics from the Middle Years Program to the Diploma Program at International Baccalaureate Schools

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**Abstract**

The purpose of this action research was to study the continuum of the mathematics curriculum from the Middle Years Program (MYP) to the Diploma Program (DP) at an IB School in Jakarta, Indonesia. To investigate the continuum of the mathematics curriculum from MYP to DP, data from the assessments of each program was collected from 2014-2016. The participants in this research were 44 grade 12 students who had already taken the DP Mathematics external examination. Their final mathematics scores were compared to their level of achievements in MYP Mathematics in grade 10. The results of the study were mixed, indicating that the continuum between MYP and DP needs more review and strengthening.



A modern education promotes 21<sup>st</sup> century skills (STEM Smart Brief, 2013) and for 21<sup>st</sup> century readiness in the area of mathematics, it is important to equip students with skills that will be applied substantially across subjects. According to U.S. Department of Commerce, there will be a significant increase of STEM occupations in the near future: up 17% while other occupational areas will grow by only 9.8% (“Why STEM education is important for everyone,” 2016). Additionally, the U.S. Department of Education predicts an increase in the fields of mathematics and biomedical engineering of up to 16% and 62% respectively. These statistics have motivated universities and colleges around the world to enhance the quality of STEM education.

The International Baccalaureate Diploma Program is a well-designed program created by experienced educators in the 1960s to educate adolescents with a depth of knowledge and skills as a pre-university preparation and as preparation for their future professional lives (IBO, “Diploma Program,” 2015). The IB Diploma Program consists of six different groups or subject areas. Mathematics is in Group 5 and each student has the opportunity to select a choice from three different level of mathematics. The three different levels include Mathematical Studies SL (Standard Level), Mathematics SL (Standard Level) and Mathematics HL (Higher Level). Each level has different objectives and curriculum content based on the different needs, interests, and abilities of its students (IBO, “DP: Mathematics SL Guide,” 2014). Mathematical Studies is designed to prepare the students to enhance their critical and analytical thinking with a wide variety of mathematical topics by applying important concepts and techniques. This group is preparing for future careers in Social Science, Humanities, Languages, and Arts. Mathematics SL (Standard Level) is a course to help and to support students who are interested in taking Chemistry, Psychology, Economy, and Business Administration. The level of knowledge and

skills at this level is more sophisticated and complex with broader and deeper topics and concepts in the curriculum content. If students decide to choose to continue their studies in Physics, Engineering, and Technology, they take Mathematics HL (Higher Level). The different levels in mathematics are provided by the International Baccalaureate to prepare students to enter the appropriate university level and future career (IBO, “DP Mathematics HL Guide,” 2014).

### **Problem**

SPH Sentul (Sekolah Pelita Harapan) is the first IB School in Indonesia authorized with all IB Programs: Primary Years Program (PYP), Middle Years Program (MYP) and Diploma Program (DP). At SPH, there have been major issues with the transition from MYP to the Diploma Program especially in Group 5 Mathematics (Hallinger, Lee, & Walker, 2012).

Unfortunately, the transition from one program to the other program has not been developed well by the school. This is especially true in Mathematics where knowledge and skills must be well-developed as early as possible and, therefore, insufficient knowledge and skills in Mathematics could restrain students from chances to excel in this subject. Some students have a desire to establish their future in Engineering and Technology; however, some of these same students have to delay their dreams since they do not have a strong understanding of the concepts and skills from their previous mathematics course in the MYP. The situation gets worse when the complaints from parents and students occur because of the big difference in curriculum content between MYP Mathematics and DP Mathematics HL.

A study conducted by Hallinger, Lee, and Walker (2011) found that many schools adopting all IB programs have found transition problems when students complete one of the programs and move on to the next. To solve this transition issue, the IB organization from Cardiff advises all IB schools to develop and identify the knowledge, concepts, and skills in the

written curriculum across the IB continuum. The International Baccalaureate Organization MYP Mathematics Guide (2015) states clearly that the criteria-based assessment and interim objectives of MYP Mathematics have been established from DP Mathematics internal and external assessments. The DP Mathematics internal assessment is a written work where each student demonstrates the application of their knowledge and skills based on their interest. The external assessment is an examination taken by each student by the end of the program.

Starting from grade 9, students at SPH are classified into two different mathematics classes: Standard and Extended Mathematics. Standard Mathematics in grade 9 and 10 is taken in preparation before entering DP Mathematics SL and Mathematical Studies SL. The Extended Mathematics class prepares gifted students in mathematics and provides preparation for taking DP Mathematics HL. To prepare students before starting DP Group 5, SPH has revamped the mathematics curriculum in MYP with significant adjustments in summative and formative assessments. In general, the curriculum content in Standard and Extended Mathematics is relatively the same although the speed to finish the curriculum will be hugely different.

Furthermore, the assessments in MYP Mathematics have been adjusted to the DP internal assessment. For example, the type of mathematics investigation in MYP Mathematics is one of the types of DP internal assessment where students ought to explore their knowledge and skills to achieve their aims. Another type of MYP assessment is the real-life problem assessment where each MYP student must be able to reflect and to evaluate the application of knowledge and skills upon his or her methods. The ability to reflect and justify methods is the goal of IB education in nurturing students to be critical and analytical thinkers.

For more than four years, SPH has been implementing the MYP Mathematics continuum to the DP Program. To a certain extent, SPH has followed the suggestions and procedures from

the IB organization to have a smooth transition from MYP to DP. Hence, it is important to examine if the continuum of MYP Mathematics to DP Group 5 has been successful. Though MYP Mathematics teachers at SPH have made attempts to create assessments more similar to the expectations in DP Mathematics, both in the internal and external assessments, there has not been any further investigation to measure the transition program in the Mathematics Department from MYP to DP.

### **Research Questions**

Prestigious universities around the world seek IB students since they have been well-trained with necessary knowledge and skills. The IB Diploma Programs contain rigorous curriculum content across six mandatory subjects and an additional philosophy class (IBO, “Diploma Program,” 2015). However, the transition between programs has been challenging because of differences in assessment strategies between the MYP and DP Programs. The type of mathematics in the Diploma Program is rigid with exact weights from internal and external assessments. However, in the MYP Program, students do not receive their assessment feedback through criteria-related assessments. All the classroom tests in MYP are assessed against criteria of knowing and understanding, with the exception of the e-Assessment (IBO, “MYP Mathematics Guide,” 2015). Additionally, there is still a significant difference in the implementation of each program. This research study was intended to conduct further investigation of the IB continuum in Mathematics from MYP to DP. In light of this further study, these research questions were examined:

- 1) To what extent is the continuum between MYP Mathematics and DP Mathematics successful?

- 2) What are the appropriate variables and parameters to measure a smooth transition from MYP to DP Group 5?
- 3) What are the components that should be added to enhance the transition period from MYP to DP in Mathematics Department?

### **Definitions of Terms**

The following definitions are provided to ensure uniformity and understanding of terms throughout the study. The researcher developed all definitions not accompanied by a citation.

*Criterion-related assessment:* The assessments in the MYP and DP program are based on criteria published in the MYP and DP guides. There are four criteria in the MYP program for all subjects. All content, knowledge, and skills are assessed against published criteria. The DP program has criterion-based assessments that are implemented when students have finished their internal assessments.

*Diploma Program Group 5:* The International Baccalaureate (IB) Program has three different programs and they are Primary Years Program, Middle Years Program, and Diploma Program. The Diploma Program is a program for students in grades 11 to 12 that offers six different groups or subject areas. Mathematics is part of Group 5.

*External Assessment:* This is the final examination after DP students have completely finished the two-year program. Usually each subject area will have two or three papers to assess what students know. The papers are designed and marked externally by the IB program. Certain weights from external and internal assessments are set differently in each subject area.

*IB Continuum:* This is a specific term used by IB Schools to describe the need for a smooth transition between levels of the program. IB expects and recommends that each IB school create a continuum program in knowledge, skills, and concepts.

*Internal Assessments:* These are requisite and written assessments in the DP program and are mandatory for each student. The internal assessments take place after DP students have sufficient knowledge, skills, and concepts. Furthermore, internal assessments are assessed based on published criteria in DP subject guides.

*MYP:* MYP is the abbreviation of the Middle Years Program. Students from grade 6-10 are in the MYP Program. Some IB Schools start MYP from grade 7 and some schools might only have grade 9 and 10 as part of the MYP Program.

*MYP e-Assessment:* This is an on-screen examination from the IB organization that assesses critical and creative thinking, problem-solving skills and the ability to apply knowledge in familiar and unfamiliar situations (IBO, “MYP,” 2015).

*STEM:* STEM is the abbreviation of Science, Technology, Engineering, and Mathematics. This abbreviation became popular when President Obama sought to enhance the quality of education in science and mathematics for middle school students.

## **Summary**

The IB Diploma Program is a rigorous program as all the courses derive from university levels. However, it is not easy to prepare MYP students as they move to the next level of the IB program, the Diploma Program. Complaints flow in as students struggle immensely when they start the Mathematics HL course. To overcome this issue, SPH has made major improvements to amend the written curriculum which includes the curriculum content, assessments, knowledge and skills. Although IB has officially suggested how to create a smooth transition between all programs, it is important for SPH to further investigate to ensure that their implementation is successful.

### **Review of the Literature**

The influence of economic globalization starting in the early 1990s placed a high demand on establishing international schools. As many multinational companies expand their businesses to other countries in East Asia, Eastern Europe, and Latin America, the number of international professionals have spread throughout the world. In developing countries, many expatriate parents put their trust in international schools to educate and to nurture their children because an international education uses English for its language instruction. At the same time, local parents are responding negatively to their own local schools for reasons such as the poor quality of local education and complicated school systems. Consequently, both expatriate and local parents join together as one team in building networks to get access to international schools (Hallinger et al, 2011).

To fulfill the need for international education by foreigners, the International Baccalaureate Organization has established an international program with best practices implemented by qualified and well-trained international teachers from around the world (Hallinger et al, 2011). In the 1960s, the International Baccalaureate launched its Diploma Program. By 2010, statistical data showed that the Diploma Program has been implemented by 2000 schools around the world (IBO, “The MYP-DP Continuum,” 2010). Approximately 400 schools in Asia Pacific have adopted one or two IB programs.

One key feature of the International Baccalaureate is that it offers an openness to cultural and value differences (IBO, “Diploma Program,” 2015). International-mindedness is the tag line used to promote the IB programs. The International Baccalaureate programs are uniquely equipped to teach students to appreciate different perspectives and to recognize that others can be right according to their beliefs and values.

The implementation of the IB philosophy in Middle Years Program (MYP) Mathematics is evident in the four different objectives used as criteria to assess students. Students learn to use deductive reasoning from different approaches until they are able to draw a conclusion with different forms of answers. This is the method used to help students train themselves to use different perspectives to solve problems. There are no fixed methods to solve mathematical problems since students are required to explore and to communicate what they think using varied mathematical symbols and representations. MYP Mathematics is structured to teach students to think creatively and critically. To deepen students' learning and to utilize 21<sup>st</sup> century skills, the MYP Program begins inquiry learning by asking questions about big ideas that continue to be applied to the methods or concepts through their actions. The goal is for students to think reflectively about the application of methods and concepts (IBO, "Middle Years," 2015).

Diploma Program Mathematics has a different nature from MYP Mathematics. DP Mathematics courses are divided into three different levels: Mathematics Higher Level (HL), Mathematics Standard Level (SL), and Mathematical Studies. According to the International Baccalaureate Organization DP Mathematics HL Guide (2014), the purpose of Mathematics HL is to prepare students with skills, analytical thinking, and concepts as a major part of their future university studies if they plan to study physics, engineering, and technology. The HL level provides complex and challenging math problems for its students. Mathematics Standard Level (SL) equips students with needed mathematical skills for their future university studies in Business Administration, Psychology, Economics, and Chemistry. In the final option, Mathematical Studies SL, applied statistics is the largest component. Students who wish to continue their future studies in Social Studies, Humanities, Languages, and the Arts, are best served by this option (IBO, "DP:Mathematics HL Guide," 2014).



The program transition from PYP (Primary Years) Program to MYP Program and from MYP Program to DP Program has been difficult (Hallinger et al, 2011). To overcome the transition problem, the International Baccalaureate Organization MYP Mathematics Guide (2015) stated that “MYP mathematics aims to build on what students learn and do in the PYP and other student-centered programs of primary education.” That statement clearly emphasizes the mathematics continuum from the primary level to the middle school level. The biggest struggle for MYP math teachers is not only managing the transition from PYP to MYP but also seeking to meet MYP math objectives based on criteria-based assessments. MYP Mathematics requires students to be able to communicate their thinking when they solve math problems using different mathematical symbols and representations, but new MYP students seemingly have difficulties organizing data into tables, diagrams or graphs and may not even know what specific conclusion or theory they have to learn. The type of assessments in PYP Mathematics and MYP Mathematics have different goals and orientations. Furthermore, some of the curricular content in PYP mathematics is not sufficient to prepare students for the curricular expectations in the MYP Mathematics course. Even though both programs were established by the IB programs, the confusion faced by IB practitioners has led to great frustration in trying to resolve this transition from PYP to MYP.

From a philosophical perspective, MYP Mathematics and DP Mathematics have similar goals toward yielding creative and critical thinkers. The Diploma Program Mathematics is designed for university preparation with assessments created to allow students to act as mathematicians or scientists (Successful STEM Education, 2013). DP Mathematics in all levels utilizes all assessments based on open-ended questions which require students to think as problem solvers from varied approaches and methods. These assessments are intended to enrich

Diploma students with 21<sup>st</sup> century skills in order to train them to have deeper critical and creative thinking skills.

Unfortunately, while there is a philosophical alignment between MYP and DP, the transition from MYP to DP is challenging. DP Mathematics teachers have complaints pertaining to students' readiness from MYP Mathematics. Students who need mathematics for their future careers also struggle with the high expectations in DP Mathematics HL compared to MYP Mathematics. Frequently, the students who have a strong desire to achieve their dreams of entering the engineering field or other field related to Mathematics HL find that they are unable to finish Mathematics HL in two years. As a result, some international schools are hesitant to adopt MYP Mathematics in their schools.

Hallinger et al (2011) conducted research to determine what factors are the cause of the problem in the transition between MYP Program to DP Program. Based on their research, Hallinger et al (2011) suggested that the DP Program in all subject areas should reduce some skills that are adopted from the university level. Many grade 11 and 12 students are not well-equipped after they finish the MYP program. Hence, the average MYP graduate will have difficulties when they start the courses in the DP program.

There are several reasons for this struggle. The first reason is that students are surprised with the fast pace of the DP courses. The DP programs is very strict with their timelines to finish the content especially in Group 5 Mathematics courses. The MYP mathematics teachers do not have any obligation to finish the curriculum content within strict timelines and the essential idea in the MYP program is the learning process in order to embed the concepts and skills strongly. Unfortunately, if the MYP Mathematics teachers do not understand DP Mathematics'

expectations, their students will encounter trouble in adapting to the demanding and high expectation in DP Mathematics courses (IBO, “DP: Mathematics SL Guide,” 2014).

The second reason for the struggle in the transition is that MYP graduates are unfamiliar with the DP external examination. The external examination in the DP program is the final stage for the DP students to pass the IB program. The external examinations in SL levels consist of two papers conducted on different days with certain weights on the final score. The MYP program does not have mandatory external examinations. (It is, however, an option for MYP students if they are interested.) Unfortunately, the majority of MYP schools do not use the external examination. The external examinations in DP Mathematics courses do not use criteria-based assessment and the DP students receive their mathematics score based on their correct answers. On the other hand, in the MYP Mathematics course, assessments are implemented based on the inquiry questions to analyze thoroughly their critical and creative thinking (IBO, “Middle Years,” 2015). Therefore, this difference in the assessments between the MYP and DP program becomes an issue in the transition process.

The last reason for the struggle in the transition is the use of the internal assessment that is an essential part of the DP mathematics courses. The internal assessment is required in both SL and HL levels (IBO, “DP: Mathematics SL Guide,” 2014; IBO, “DP: Mathematics HL Guide,” 2014). The DP internal assessment requires each student to choose his or her topic independently and apply one of the mathematics skills in the curriculum. The internal assessment is the most challenging task in this course since the DP students only have twenty hours to complete this task without teachers’ intervention. The MYP Mathematics does not have time constraints to let the MYP students complete their assessments (IBO, “Middle Years,” 2015).

This difference in internal assessments is another reason it takes time for MYP graduates to adapt to the DP program.

The International Baccalaureate Organization MYP-DP Continuum (2010) published by International Baccalaureate provides advice regarding the transition issue between programs in IB World Schools. It is advised that each IB school start curriculum articulation with both vertical and horizontal planning. Vertical planning ensures that the curriculum is well developed to prepare students to move to the next level and horizontal planning ensures that each curriculum is linked to other subjects for that same level. The purpose is to create integral units from different subjects. It is the school's responsibility to create a smooth transition from MYP Mathematics to DP Mathematics. The IB suggests creating pathways from MYP Mathematics to DP Mathematics by classifying the MYP mathematics class into Standard Mathematics and Extended Mathematics. Each school determines which MYP students are placed in the Standard or Extended Mathematics class. MYP Extended Mathematics in the MYP Program is intended to prepare students to continue their course in Mathematics HL or SL. MYP Standards Mathematics is intended to facilitate students who expect to join DP Math SL course although they still have the opportunity to choose DP Math HL (IBO, "Middle Years," 2015).

### **Methods**

Based on research conducted by Hallinger et al (2011), it is clear that there is a major issue in the smooth transition from one program to another program among IB schools. In this study, the main focus was on the major issue in the mathematics transition from the Middle School (MYP) to the Diploma Program (DP). The International Baccalaureate officially suggests to all IB schools that they take further steps in developing vertical and horizontal curricular planning. This research study sought to examine how well MYP Mathematics at SPH Sentul City

establishes a smooth transition to the Diploma Program through the MYP assessments and the DP external and internal examination.

### **Participants**

The participants in this research were 44 grade 12 students who had already taken the DP Mathematics external examination. Their final mathematics scores were compared to their level of achievements in MYP Mathematics in grade 10. The participants were chosen randomly from three different levels of the DP Math course consisting of Mathematics Higher Level (HL), Mathematics Standard Level (SL) and Mathematical Studies SL (Studies).

### **Materials**

To measure the correlation of MYP Math and DP Math, the participants' final scores were calculated for the regression value ( $r$ ) using Pearson's Correlation Coefficient. In order to measure the smooth transition from MYP to DP, each student's grades in MYP and DP Math were recorded according to the scale of each program.

The MYP Math score was taken from their Grade 10 scores in the last quarter with four different criteria: knowing and understanding (Criterion A), investigating patterns (Criterion B), communicating (Criterion C), and applying mathematics in real life context (Criterion D). To determine the MYP Math final score, the researcher relied on students' consistency from each criterion score since there was no way to average the mathematics score from each criterion.

The DP external examination score was taken from the average of two or three papers and the internal assessment score was the result of the addition from five or seven criteria. The final results of DP mathematics score were taken from the average of the external and internal assessments.

**Design**

The MYP Mathematics scores were the independent variables. All MYP Mathematics assessments are judged by each criterion without assigning certain weights. Assessments are graded based on the teacher's subjective judgement against the criterion of knowing and understanding. All MYP Math content in grade 9 and 10 is derived from DP Math SL. Therefore, the preparation in the last year of MYP program should be sufficient to prepare MYP students to join DP Math courses in all three levels.

The DP Math scores were the dependent variables. The DP Math course has rigid weights to set the final score: the test has an 80% weight with no specific criterion with the remaining 20% coming from internal assessments graded by six different criteria.

The Math teachers from both programs were the same so there was no significant difference in judging students' work. The internal assessments in DP Math were graded by the teachers and moderated by IB moderators to check the validity of teachers' judgements.

**Procedure**

The researcher used data from grade 12 students who had already finished their DP external examination in 2014 – 2016. The first step was to collect the data from the DP internal and external assessments. The external examination in Mathematics Standard Level and Mathematical Studies SL consists of two papers each scored out of 90 marks. The data recorded included the scores out of 90 and the 7 marks from both paper 1 and 2.

DP Mathematics HL had different ranges of scores for the three papers: paper one and two consist of 120 marks and paper three had overall 60 marks. The same treatment was applied as

was used in Mathematics SL and Mathematical Studies SL, with the 120 and 60 marks transferred to the final score out of seven.

After the data was collected, the second step was the calculation of the regression from five different sets of comparisons between the MYP Math score and the DP Math score. The following are the five sets from the data collection:

1. MYP Math score from Criterion A against DP Paper 1 examination
2. MYP Math score from Criterion A against DP Paper 2 examination
3. MYP Math score from Criterion A against Average DP external examination
4. MYP Math final score from accumulation of all criteria against DP Examination final score
5. MYP Math project (the sum of Criteria B, C and D) against DP Internal Assessment score

From those five different sets, the researcher analyzed by comparing the regression values. If the analysis revealed high regression values approaching +1, it would indicate that the school had made a successful transition from MYP to DP. If the analysis revealed low regression values approaching 0, the MYP Math curriculum would need to revamp its system of assessments.

## **Results**

### **Data Analysis**

This study sought to investigate thoroughly the correlation between MYP Mathematics and DP Mathematics in hopes of creating a more seamless transition from MYP to DP. SPH Sentul has revamped its MYP Mathematics curriculum so that the content of MYP Mathematics is predominantly taken from DP Mathematics SL content. This continuum program from MYP to

DP in the Mathematics Department was initially implemented approximately five years ago. Although MYP Mathematics teachers in grade 10 are also DP Mathematics teachers in all levels, the continuum of learning still has problems especially since DP students must learn some topics which they have not yet learned in MYP Mathematics. This study's purpose was to examine how successful the continuum program in the Mathematics Department has been during the transition from MYP Mathematics to Diploma Program in Group 5.

The results of the raw data have illustrated trends from both programs. The components of the raw data encompass all the criteria scores in MYP Mathematics. Table 1 presents the raw data from the results of MYP math scores and DP Math SL scores. MYP Math Test applies criterion A, the criterion of knowing and understanding. The scale of MYP Math Test was measured out of eight and DP External Examination both Paper 1 and 2 has the scale out of seven. The internal assessment in Diploma Program is graded out of 20 marks with five different criteria. Although the five categories of each criterion in Mathematics Standard and High Level are the same, the last criterion will be applied based on the level of choice mathematical process according to the syllabus in Mathematics Standard and High Level.



Table 1

*The Results of MYP Math Scores and DP Math SL Scores*

	MYP Math Scores			DP Math SL Scores				
	Criterion A	Math Project	Final Score	Paper 1	Paper 2	Average of External Examination	Internal Assessment	Final Score
Student 1	6	15	5	63	60	61.5	12	5
Student 2	5	12	4	43	47	45	12	4
Student 3	5	9	4	30	51	40.5	10	3
Student 4	5	14	5	50	53	51.5	11	4
Student 5	6	13	5	52	39	45.5	9	4
Student 6	6	9	4	61	50	55.5	9	4
Student 7	7	16	6	89	62	75.5	17	7
Student 8	4	8	4	67	63	65	12	6
Student 9	5	11	4	82	57	69.5	14	6
Student 10	6	14	5	81	75	78	14	7
Student 11	5	10	4	44	54	49	13	4
Student 12	5	11	4	34	25	29.5	14	3
Student 13	5	11	4	65	57	61	13	5
Student 14	6	13	5	80	73	76.5	9	6
Student 15	6	16	6	52	51	51.5	10	4
Student 16	6	13	5	86	57	71.5	10	6
Student 17	4	10	4	47	45	46	10	4
Student 18	6	11	4	52	46	49	10	4
Student 19	4	12	4	39	38	38.5	10	3
Student 20	4	9	4	51	33	42	6	3
Student 21	4	10	4	49	30	39.5	6	3
Student 22	4	10	4	21	15	18	6	2
Student 23	3	10	4	52	58	55	8	4
Student 24	5	12	4	49	63	56	10	4
Student 25	3	10	4	43	41	42	9	3
Student 26	3	9	3	32	47	39.5	19	4
Student 27	2	9	3	38	44	41	12	3
Student 28	2	7	3	15	29	22	9	2

Table 2 illustrates the results of the correlation between the MYP Mathematics test and the DP external examination at all papers with the same students. The p-values from those three categories is less than 0.05 meaning that there is a significant correlation between the MYP

Mathematics test and the DP Math SL Paper 1, Paper 2, and the average of the external examination score. The correlations between the DP Paper 1 Mathematics SL and the DP average external examination against the MYP Math Test in Criterion A are moderately positive. It is assumed that higher grades in MYP Mathematics will give students a greater opportunity to attain higher grades in DP Paper 1 and overall papers of DP external examination. However, the correlation of MYP Mathematics against DP Paper 2 Math SL is lower than the others. The researcher believes that perhaps this occurred because the students in MYP program did not explore how to use graphic display calculators to solve mathematical problems.

Table 2

*Correlation Coefficient Values (r) between MYP Math Test and DP Mathematics Standard Level*

<i>Correlation Coefficient Values (r) and p-Values</i>			
	DP Paper 1	DP Paper 2	Average DP External
	Examination	Examination	Examination
MYP Math Test			
(Criterion A only)	0.6525	0.4641	0.6120
p-Values	0.000168	0.0129	0.000539

Note. P-Value = 0.05

Table 3 presents the raw data from the results of MYP math scores and DP Mathematical Studies SL scores. The students do not pass their MYP math test if the students achieve below four out of eight marks. Moreover, the students with low scores on their MYP math test will receive mostly below forty-five marks out of ninety marks from the average scores of two papers. This indicates that the students who want to achieve higher score on their external

examination in Diploma Program, must do well on their MYP math test. There is also inconsistent data from Table 3 that the students with scores of five on their MYP math test attain the highest score and a low score on their external examination in Mathematical Studies SL. This data shows that the MYP Mathematics contents can cater to the students in Mathematical Studies SL. Although the Mathematical Studies SL students have already learned some of the content in MYP mathematics, the students must have the independency to learn and review the materials before they take the external examination. It is evident that the student who achieve four marks on MYP math test, has the chance to attain sixty-one marks from both papers.

Table 3

*The Results of MYP Math Scores and DP Mathematical Studies SL Scores*

	MYP Math Scores			DP Mathematical Studies SL Scores				
	Criterion A	Math Project	Final Score	Paper 1	Paper 2	Average of External Examination	Internal Assessment	Final Score
Student 1	5	14	5	80	60	70	16	6
Student 2	4	12	4	69	53	61	15	6
Student 3	3	11	4	47	45	46	14	4
Student 4	4	9	4	51	41	46	8	4
Student 5	3	6	3	47	51	49	9	4
Student 6	3	9	3	47	35	41	8	4
Student 7	2	6	2	39	32	35.5	8	3
Student 8	3	8	3	29	26	27.5	5	2
Student 9	3	8	3	23	17	20	8	2
Student 10	4	10	4	43	35	39	13	4
Student 11	4	10	4	45	46	45.5	16	5
Student 12	5	13	5	34	33	33.5	13	4

The data results between the MYP mathematics test and the DP Mathematical Studies SL external examinations are quite different than those between MYP mathematics test and DP Mathematics SL. Table 4 shows that all p-values are larger than 0.05 meaning that there is no

significant correlation statistically between those variables. Moreover, the correlations between MYP mathematics test and all papers in DP Mathematical Studies SL external examinations are moderately weak. Table 4 shows these inconsistent results. There are two students who achieve five marks out of eight marks on their MYP math test and those two students attain high and low scores on their external examination from both papers. Furthermore, there are few students who have achieved four marks on MYP math test and they merely receive lower scores on their Mathematical Studies SL external examination. And the students who have lower grades on MYP math test apparently have the chance to obtain higher scores on their Mathematical Studies SL external examination.

Table 4

*Correlation Coefficient Values (r) between MYP Math Test and DP Mathematical Studies Standard Level*

<i>Correlation Coefficient Values (r) and p-Values</i>			
	DP Paper 1	DP Paper 2	Average DP External
	Examination	Examination	Examination
MYP Math Test			
(Criterion A only)	0.4729	0.4345	0.4673
p-Values	0.120	0.158	0.126

Note. P-Value = 0.05

Table 5 presents the raw data from the results of MYP math scores and DP Math HL scores. Criterion A is called knowing and understanding. Only four students from MYP Mathematics took DP Math HL from 2014-2016. SPH is not strict about which MYP students are allowed to take DP Math HL. The school gives the opportunity to all MYP students to take

DP Math HL. However, the school will give recommendations as to which students will stay in that course.

Table 5

*The Results of MYP Math Scores and DP Math HL Scores*

	MYP Math Scores			DP Math HL Scores					
	Criterion A	Math Project	Final Score	Paper 1	Paper 2	Paper 3	Average of External Examination	Internal Assessment	Final Score
Student 1	6	16	6	62	68	40	56.6667	13	5
Student 2	6	12	5	32	35	22	29.6667	9	3
Student 3	5	12	4	19	44	26	29.6667	7	3
Student 4	6	14	5	63	67	29	53	11	5

There is a significant difference between MYP Mathematics and DP Mathematics HL. Many IB schools have struggled to create a smooth transition between MYP and DP Mathematics HL. Although SPH Sentul already revamped its curriculum in MYP Mathematics, the results in Table 6 clearly illustrates that there are no significant correlations between the variables. All p-values are bigger than 0.05. Only the DP Paper 1 Mathematics HL against the MYP Mathematics test has a high correlation although there is no significant correlation according to the p-values.

The results clearly point out that the MYP Mathematics curriculum cannot cater to students' learning in DP Mathematics HL. The level of Mathematics HL is meant for students who are able to learn sophisticated concepts of pure mathematics. The students who take DP Math HL must have high skills and knowledge accompanied by good motivation.

Table 6

*Correlation Coefficient Values (r) between MYP Math Test and DP Mathematics Higher Level*

<i>Correlation Coefficient Values (r) and p-Values</i>				
	DP Paper 1	DP Paper 2	DP Paper 3	Average DP
	Examination	Examination	Examination	External
				Examination
MYP Math Test	0.7570	0.3820	0.2807	0.5743
(Criterion A only)				
p-Values	0.243	0.618	0.719	0.426

Note. P-Value = 0.05

In Table 7, the correlations between the MYP Math final score (including all the four criteria) and the DP Mathematics final score (including both external and internal assessment) are strong and positive in all DP Math courses in Group 5. Meanwhile, the significant correlations between the MYP Math final score with DP Mathematics SL and Mathematical Studies SL are less than 0.05 and there is a valid correlation between those variables. Conversely, there is no significant correlation between the MYP Mathematics final score and the DP Mathematics HL final score although the correlation value is strongly positive.

Finally, the researcher examined the data results to determine how close the correlations were between the MYP Project and the DP internal assessment. MYP Projects contain three different criteria: Criterion B (Investigating the Pattern), Criterion C (Communicating in Mathematics) and Criterion D (Applying Mathematics in Real-Life). The DP internal assessments in Mathematics SL and HL are independent and individual tasks which the students

ideally finish within 10 teaching hours. Mathematical Studies SL has an independent and individual assignment called the Project that students have the opportunity to complete within 25 teaching hours. Only the MYP Math Project and the DP Mathematical Studies SL internal assessment have a significant correlation less than 0.05 with highly positive correlation.

Table 7

*Correlation Coefficient Values (r) between MYP Math Final Scores and DP Mathematics External Examination Final Score*

	<i>Correlation Coefficient Values (r) and p-Values</i>		
	DP Mathematics	DP Mathematical	DP Mathematics
	SL	Studies SL	HL
MYP Final Scores	0.5697	0.6405	0.7071
p-Values	0.00155	0.0248	0.293

Note. P-Value = 0.05

The data suggests that MYP students who are successful in the MYP Math Project will achieve higher scores in the DP Mathematical Studies SL Internal Assessment. Conversely, the MYP Math Project will not help MYP students to achieve higher grades in DP Mathematics SL internal assessment since the correlation between those variables is moderately weak.

The DP Mathematics HL internal assessment is higher when the MYP Math Project is also higher. However, since the p-value is slightly greater than 0.05, success in the MYP Math Project will not determine success in the DP Mathematics HL internal assessment. The MYP Math Project is not independent task where the students can choose their own topics. Most of the time, MYP Math teachers provide the open-ended mathematical investigation or real-life problems and guide the students to solve the problems from multitude approaches.

Table 8

*Correlation Coefficient Values (r) between MYP Mathematics Project and DP Mathematics Internal Assessment*

	<i>Correlation Coefficient Values (r) and p-Values</i>		
	DP Mathematics	DP Mathematical	DP Mathematics
	SL	Studies SL	HL
MYP Mathematics Project	0.2328	0.7675	0.9439
p-Values	0.233	0.00357	0.0561

Note. P-Value = 0.05

### Discussion

Overall, the success of the continuum between MYP Mathematics and DP Mathematics in SPH Sentul has not yet been achieved in all areas. The correlations between the MYP Math test and the DP external examination from all papers have positive correlations in the DP Mathematics SL external examination. The other component measured was the correlation between the MYP final score from all criteria and the DP final score from both the external and internal assessments; the result was the MYP final scores indeed affected the DP final score in Mathematics SL and Mathematical Studies SL. However, SPH Sentul must develop the MYP Math Project in order to help those students reach greater achievement in completing their internal assessments in all DP Mathematics levels.

SPH Sentul has been fully aware with the gap between the MYP and the DP program in Mathematics Department. The solution has been to build the MYP content from the DP Mathematics SL curriculum. According to the results of this research, the current MYP Math



content has not contributed significantly to help students to be successful in the DP Math programs.

The MYP Mathematics curriculum has adopted DP Mathematics SL content but it seems that the content of MYP Mathematics is not enough to meet students' learning needs in the DP Mathematical Studies SL course. Some of the content in DP Mathematics SL is completely different from what the students learn in Mathematical Studies SL course. For example, students who take Mathematical Studies SL never learn about Logic and Bivariate Data. Many IB teachers and students already know that Mathematical Studies SL is the easiest course in Mathematics program. However, for some students, the curriculum can be relatively difficult and challenging since the application of mathematics is strongly emphasized.

### **Recommendations**

To facilitate the smooth transition to DP Programs in Group 5, this researcher recommends that SPH Sentul reconsider the MYP Math content and suggests that the school combine content from DP Group 5 at all levels. Additionally, the researcher recommends that MYP Mathematics give their students the opportunity to start their math projects independently based on their own interest. The researcher also recommends that the MYP allow students to use GDC (graphic display calculator) to solve mathematics problems since DP Mathematical Studies SL rely on the use of calculator in their final examinations. Finally, the timeline to finish the content in MYP Mathematics should perhaps be one of the considerations in making a smooth transition between both programs. DP Mathematics is a rigorous program and the MYP Program should be able to balance its content and timeline with the needs in a higher program.

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